

AMENDMENTS TO THE CLAIMS

This listing of claims will replace all prior versions, and listings, of claims in the application:

Listing of Claims:

- 1 1. (Currently amended) A method for generating code to perform
2 anticipatory prefetching for data references, comprising:
3 receiving code to be executed on a computer system;
4 analyzing the code to identify data references to be prefetched, wherein the
5 data references are identified from basic blocks within *if* conditions regardless of
6 whether the basic blocks are likely to execute, and wherein analyzing the code
7 involves,
8 performing a first marking phase in which only data
9 references located in blocks that are certain to execute are
10 considered in determining which data references are covered by
11 preceding data references, and
12 performing a second marking phase in which data
13 references that are located in blocks that are not certain to execute
14 are considered;
15 calculating a prefetch ahead distance, wherein the prefetch ahead distance
16 indicates the number of loop iterations ahead to prefetch for, and wherein the
17 prefetch ahead distance is calculated as a function of loop characteristics within
18 the code, as well as processor characteristics of the computer system; and
19 inserting prefetch instructions into the code in advance of the identified
20 data references based upon the prefetch ahead distance, wherein inserting prefetch

21 instructions includes inserting multiple redundant prefetch instructions for a given
22 data reference;
23 wherein inserting multiple redundant prefetch instructions involves
24 inserting the multiple redundant prefetch instructions into unused instruction slots,
25 and wherein executing multiple redundant prefetch instructions potentially avoids
26 a cache miss.

1 2. (Original) The method of claim 1, further comprising:
2 profiling execution of the code to produce profiling results; and
3 using the profiling results to determine whether a given block of
4 instructions is executed frequently enough to perform the second marking phase
5 on the given block of instructions.

1 3. (Original) The method of claim 2, wherein determining whether the
2 given block of instructions is executed frequently enough to perform the second
3 marking phase involves comparing a frequency of execution for the given block
4 from the profiling results with a threshold value indicating a minimum frequency
5 of execution to be considered in the second marking phase.

1 4. (Original) The method of claim 1, wherein analyzing the code involves:
2 identifying loop bodies within the code; and
3 identifying data references to be prefetched from within the loop bodies.

1 5. (Original) The method of claim 4, wherein if there exists a nested loop
2 within the code, analyzing the code involves:
3 examining an innermost loop in the nested loop; and

4 examining a loop outside the innermost loop if the innermost loop is
5 smaller than a minimum size or is executed fewer than a minimum number of
6 iterations.

1 6. (Original) The method of claim 4, wherein analyzing the code to
2 identify data references to be prefetched involves examining a pattern of data
3 references over multiple loop iterations.

1 7. (Original) The method of claim 1, wherein analyzing the code involves
2 analyzing the code within a compiler.

1 8. (Currently amended) A computer-readable storage medium storing
2 instructions that when executed by a computer cause the computer to perform a
3 method for generating code to perform anticipatory prefetching for data
4 references, the method comprising:
5 receiving code to be executed on a computer system;
6 analyzing the code to identify data references to be prefetched, wherein the
7 data references are identified from basic blocks within *if* conditions regardless of
8 whether the basic blocks are likely to execute, and wherein analyzing the code
9 involves,

10 performing a first marking phase in which only data
11 references located in blocks that are certain to execute are
12 considered in determining which data references are covered by
13 preceding data references, and
14 performing a second marking phase in which data
15 references that are located in blocks that are not certain to execute
16 are considered;

17 calculating a prefetch ahead distance, wherein the prefetch ahead distance
18 indicates the number of loop iterations ahead to prefetch for, and wherein the
19 prefetch ahead distance is calculated as a function of loop characteristics within
20 the code as well as processor characteristics of the computer system; and
21 inserting prefetch instructions into the code in advance of the identified
22 data references based upon the prefetch ahead distance, wherein inserting prefetch
23 instructions includes inserting multiple redundant prefetch instructions for a given
24 data reference;
25 wherein inserting multiple redundant prefetch instructions involves inserting the
26 multiple redundant prefetch instructions into unused instruction slots, and wherein
27 executing multiple redundant prefetch instructions potentially avoids a cache miss.

1 9. (Original) The computer-readable storage medium of claim 8, wherein
2 the method further comprises:
3 profiling execution of the code to produce profiling results; and
4 using the profiling results to determine whether a given block of
5 instructions is executed frequently enough to perform the second marking phase
6 on the given block of instructions.

1 10. (Original) The computer-readable storage medium of claim 9, wherein
2 determining whether the given block of instructions is executed frequently enough
3 to perform the second marking phase involves comparing a frequency of
4 execution for the given block from the profiling results with a threshold value
5 indicating a minimum frequency of execution to be considered in the second
6 marking phase.

1 11. (Original) The computer-readable storage medium of claim 8, wherein
2 analyzing the code involves:

3 identifying loop bodies within the code; and

4

5 identifying data references to be prefetched from within the loop bodies.

1 12. (Original) The computer-readable storage medium of claim 11,

2 wherein if there exists a nested loop within the code, analyzing the code involves:

3 examining an innermost loop in the nested loop; and

4 examining a loop outside the innermost loop if the innermost loop is

5 smaller than a minimum size or is executed fewer than a minimum number of

6 iterations.

1 13. (Original) The computer-readable storage medium of claim 11,

2 wherein analyzing the code to identify data references to be prefetched involves

3 examining a pattern of data references over multiple loop iterations.

1 14. (Previously presented) The computer-readable storage medium of

2 claim 8, wherein analyzing the code involves analyzing the code within a

3 compiler.

1 15. (Currently amended) An apparatus that generates code to perform

2 anticipatory prefetching for data references, comprising:

3 a receiving mechanism that is configured to receive code to be executed on
4 a computer system;

5 an analysis mechanism that is configured to analyze the code to identify
6 data references to be prefetched, wherein the data references are identified from
7 basic blocks within *if* conditions regardless of whether the basic blocks are likely
8 to execute, and wherein the analysis mechanism is configured to,

9 perform a first marking phase in which only data references
10 located in blocks that are certain to execute are considered in
11 determining which data references are covered by preceding data
12 references, and to
13 perform a second marking phase in which data references
14 that are located in blocks that are not certain to execute are
15 considered;
16 a calculating mechanism that is configured to calculate a prefetch ahead
17 distance, wherein the prefetch ahead distance indicates the number of loop
18 iterations ahead to prefetch for, and wherein the prefetch ahead distance is
19 calculated as a function of loop characteristics within the code as well as
20 processor characteristics of the computer system; and
21 an insertion mechanism that is configured to insert prefetch instructions
22 into the code in advance of the identified data references based upon the prefetch
23 ahead distance, wherein inserting prefetch instructions includes inserting multiple
24 redundant prefetch instructions for a given data reference;
25 wherein inserting multiple redundant prefetch instructions involves
26 inserting the multiple redundant prefetch instructions into unused instruction slots,
27 and wherein executing multiple redundant prefetch instructions potentially avoids
28 a cache miss.

1 16. (Original) The apparatus of claim 15, further comprising a profiling
2 mechanism that is configured to profile execution of the code to produce profiling
3 results;

4 wherein the analysis mechanism is configured to use the profiling results
5 to determine whether a given block of instructions is executed frequently enough
6 to perform the second marking phase on the given block of instructions.

1 17. (Original) The apparatus of claim 16, wherein the analysis mechanism
2 is configured to compare a frequency of execution for the given block from the
3 profiling results with a threshold value indicating a minimum frequency of
4 execution to be considered in the second marking phase.

1 18. (Original) The apparatus of claim 15, wherein the analysis mechanism
2 is configured to:
3 identify loop bodies within the code; and to
4 identify data references to be prefetched from within the loop bodies.

1 19. (Original) The apparatus of claim 18, wherein if there exists a nested
2 loop within the code, the analysis mechanism is configured to:
3 examine an innermost loop in the nested loop; and to
4 examine a loop outside the innermost loop if the innermost loop is smaller
5 than a minimum size or is executed fewer than a minimum number of iterations.

1 20. (Original) The apparatus of claim 18, wherein the analysis mechanism
2 is configured to examine a pattern of data references over multiple loop iterations.

1 21. (Original) The apparatus of claim 15, wherein the apparatus resides
2 within a compiler.

1 22-45 (Canceled).